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An authoritative overview of current research in this exciting interdisciplinary field.

Evolutionary Algorithms (EAs) now provide mature optimization tools that have successfully been applied to many problems, from designing antennas to complete robots, and provided many human-competitive results. In robotics, the integration of EAs within the engineer's toolbox made tremendous progress in the last 20 years and proposes new methods to address challenging problems in various setups: modular robotics, swarm robotics, robotics with non-conventional mechanics (e.g. high redundancy, dynamic motion, multi-modality), etc. This book takes its roots in the workshop on "New Horizons in Evolutionary Design of Robots" that brought together researchers from Computer Science and Robotics during

the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS-2009) in Saint Louis (USA). This book features extended contributions from the workshop, thus providing various examples of current problems and applications, with a special emphasis on the link between Computer Science and Robotics. It also provides a comprehensive and up-to-date introduction to Evolutionary Robotics after 20 years of maturation as well as thoughts and considerations from several major actors in the field. This book offers a comprehensive introduction to the current trends and challenges in Evolutionary Robotics for the next decade.

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An overview of the basic concepts and methodologies of

evolutionary robotics, which views robots as autonomous artificial organisms that develop their own skills in close interaction with the environment and without human intervention.

This invaluable book comprehensively describes evolutionary robotics and computational intelligence, and how different computational intelligence techniques are applied to robotic system design. It embraces the most widely used evolutionary approaches with their merits and drawbacks, presents some related experiments for robotic behavior evolution and the results achieved, and shows promising future research directions. Clarity of explanation is emphasized such that a modest knowledge of basic evolutionary computation, digital circuits and engineering design will suffice for a thorough understanding of the material. The book is ideally suited to computer scientists, practitioners and researchers keen on computational intelligence techniques, especially the evolutionary algorithms in autonomous robotics at both the hardware and software levels. Sample Chapter(s). Chapter 1: Artificial Evolution Based Autonomous Robot Navigation (184 KB). Contents: Artificial Evolution Based Autonomous Robot Navigation; Evolvable Hardware in Evolutionary Robotics; FPGA-Based Autonomous Robot Navigation via Intrinsic Evolution; Intelligent Sensor Fusion and Learning for Autonomous Robot Navigation; Task-Oriented Developmental Learning for Humanoid Robots; Bipedal Walking Through Reinforcement Learning; Swing Time Generation for Bipedal Walking Control Using GA Tuned Fuzzy Logic Controller; Bipedal Walking: Stance Ankle Behavior Optimization Using Genetic Algorithm. Readership: Researchers in evolutionary robotics, and graduate and advanced undergraduate students in computational intelligence.

This book examines how two distinct strands of research on autonomous robots, evolutionary robotics and humanoid robot research, are converging. The book will be valuable for researchers

2014 and postgraduate students working in the areas of evolutionary robotics and bio-inspired computing.

The truth about robots: two experts look beyond the hype, offering a lively and accessible guide to what robots can (and can't) do. There's a lot of hype about robots; some of it is scary and some of it utopian. In this accessible book, two robotics experts reveal the truth about what robots can and can't do, how they work, and what we can reasonably expect their future capabilities to be. It will not only make you think differently about the capabilities of robots; it will make you think differently about the capabilities of humans. Ruth Aylett and Patricia Vargas discuss the history of our fascination with robots—from chatbots and prosthetics to autonomous cars and robot swarms. They show us the ways in which robots outperform humans and the ways they fall woefully short of our superior talents. They explain how robots see, feel, hear, think, and learn; describe how robots can cooperate; and consider robots as pets, butlers, and companions. Finally, they look at robots that raise ethical and social issues: killer robots, sexbots, and robots that might be gunning for your job. Living with Robots equips readers to look at robots concretely—as human-made artifacts rather than placeholders for our anxieties. Find out: ⬛Why robots can swim and fly but find it difficult to walk ⬛Which robot features are inspired by animals and insects ⬛Why we develop feelings for robots ⬛Which human abilities are hard for robots to emulate

Topics include self-organization, the origins of life, natural selection, evolutionary computation, neural networks, communication, artificial worlds, software agents, philosophical issues in artificial life, ethical problems, and learning and development. Researchers in artificial life attempt to use the physical representation of lifelike phenomena to understand the organizational principles underlying the dynamics of living systems. The goal of the 1997 European Conference on Artificial Life is to

provoke new understandings of the relationships between the natural and the artificial. Topics include self-organization, the origins of life, natural selection, evolutionary computation, neural networks, communication, artificial worlds, software agents, philosophical issues in artificial life, ethical problems, and learning and development.

The two volumes LNCS 9597 and 9598 constitute the refereed conference proceedings of the 19th European Conference on the Applications of Evolutionary Computation, EvoApplications 2016, held in Porto, Portugal, in March/April 2016, co-located with the Evo* 2016 events EuroGP, EvoCOP, and EvoMUSART. The 57 revised full papers presented together with 17 poster papers were carefully reviewed and selected from 115 submissions. EvoApplications 2016 consisted of the following 13 tracks: EvoBAFIN (natural computing methods in business analytics and finance), EvoBIO (evolutionary computation, machine learning and data mining in computational biology), EvoCOMNET (nature-inspired techniques for telecommunication networks and other parallel and distributed systems), EvoCOMPLEX (evolutionary algorithms and complex systems), EvoENERGY (evolutionary computation in energy applications), EvoGAMES (bio-inspired algorithms in games), EvoIASP (evolutionary computation in image analysis, signal processing, and pattern recognition), EvoINDUSTRY (nature-inspired techniques in industrial settings), EvoNUM (bio-inspired algorithms for continuous parameter optimization), EvoPAR (parallel implementation of evolutionary algorithms), EvoRISK (computational intelligence for risk management, security and defence applications), EvoROBOT (evolutionary robotics), and EvoSTOC (evolutionary algorithms in stochastic and dynamic environments).

Today, autonomous robots are used in a rather limited range of applications such as exploration of inaccessible locations, cleaning

floors, mowing lawns etc. However, ongoing hardware improvements (and human fantasy) steadily reveal new robotic applications of significantly higher sophistication. For such applications, the crucial bottleneck in the engineering process tends to shift from physical boundaries to controller generation. As an attempt to automatize this process, Evolutionary Robotics has successfully been used to generate robotic controllers of various types. However, a major challenge of the field remains the evolution of truly complex behavior. Furthermore, automatically created controllers often lack analyzability which makes them useless for safety-critical applications. In this book, a simple controller model based on Finite State Machines is proposed which allows a straightforward analysis of evolved behaviors. To increase the model's evolvability, a procedure is introduced which, by adapting the genotype-phenotype mapping at runtime, efficiently traverses both the behavioral search space as well as (recursively) the search space of genotype-phenotype mappings. Furthermore, a data-driven mathematical framework is proposed which can be used to calculate the expected success of evolution in complex environments.

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